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(Please use the same title listed on MORSS Form 712 A/B. If the title was changed please list the revised title below.) Revised title:

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Technology to the Warfighter Quicker

Report Documentation Page

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AMSAA Verification and Validation of the Infantry Warrior Simulation

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Overview

- IWARS Background

- Verification and Validation of IWARS Version 1.0

    - Process

    - Tools and Techniques

    - Areas of Review

- Sample V&V Results

- Release Approval

- Current Status

Technology to the Warfighter Quicker

Brief Description of IWARS

IWARS is:

- Analysis driven
- Entity-based
- Multi-sided simulation
- Focused on individual and small-unit dismounted combatants and their equipment
- Used to assess operational effectiveness across the spectrum of missions, environments and threats

IWARS v1.0 Approved For:

- Soldier Sensor Performance Analyses
- Soldier Small-Arms Lethality Analyses
- Soldier Survivability Analyses
- Limited Situational Awareness / Battle Command Analyses

Army Requires Small Unit Combat Simulation Capabilities to Address Integrated "Soldier-as-a-System" Issues

Technology to the Warfighter Quicker

IWARS Development & Collaboration Team

AMSAA
- Standard physical algorithms
- Certified weapon performance/ characteristics database
- Soldier behavior representation, algorithms, and data
- VV&A experience

ARL-HRED
- Human system representation
- Provide critical decision req'ts pertaining to small unit ops
- IMPRINT: Emphasizes physical, perceptual, and cognitive workload

Natick Soldier Center
- Representation of warrior systems and systems integration
- Soldier behavior and performance representation
- Autonomous agent technology
- Modeling technology

TRADOC
- FACTs
- Military expertise
- Scenario development
- TTP (behavior) development
- COMBAT^{XXI}

Other efforts and organizations
- ATOs, SBIRs, etc.
- NVESD, NPS, USMA
- FFW, PEO Soldier,
- MATREX, OneSAF
- USMC, USAF, Joint CB
- Int'l Collaboration

IWARS
INFANTRY WARRIOR SIMULATION

Leverage Multiple Organizations' Key Competencies

Technology to the Warfighter Quicker

V&V Purpose

Purpose of M&S V&V:

- Ensure model functions as originally conceived and designed (AR 5-11)
- Ensure the model's credibility in its depiction of real-world functions (AR 5-11)

IWARS V&V Purpose:

- Show simulation functions properly and is easy to use
- Examine model architecture to ensure its stability and flexibility
- Examine software for correctness, efficiency, and maintainability
- Find and correct problems with the model's implementation
- Perform pilot study to show model is ready for analyses
- Ensure documentation exists and is clear and correct
- Ensure Configuration Management (CM) process in place and functioning properly

Ensures Model is Doing it Right, and Doing the Right Thing

Technology to the Warfighter Quicker

V&V Guidance

V&V consistent with guidance provided by:

- DoD Modeling and Simulation (M&S) Management, DoD Directive 5000.59

- DoD Modeling and Simulation (M&S) Verification, Validation and Accreditation (VV&A), DoD Instruction 5000.61

- Army Model and Simulation Management Program, Army Regulation 5-11

V&V Process

- **Verification Testing:**
  - Perform tests on individual behaviors and methodologies
  - Perform Integration tests to assess model in its entirety
  - Perform limited study (e.g. weapons trade, sensor trade)
  - Review documentation for correctness

- **Validation:**
  - Methodologies – Reviewed by SMEs to check equations, data, procedures (Mounted Combat Team, Target Acquisition Team, Infantry Warrior Team)
  - Behaviors – Reviewed by SMEs to assess tactical correctness of soldier behaviors (USAIC, US Marine Corps, Infantry Warrior Team)

- **Pilot Study:**
  - Employ IWARS as it will be used for analyses
  - Identify problems not discovered during testing
  - Show that IWARS output varies appropriately to changes in scenario (weapons/equipment, behaviors, situations, etc)
  - Demonstrate IWARS suitability for Army studies
    - Soldier Sensor Performance Analyses
    - Soldier Small-Arms Lethality Analyses
    - Soldier Small-Arms Delivery Accuracy Analyses
    - Soldier Survivability Analyses
    - Limited C4I/SA

IWARS V&V Will Ensure IWARS Analysis Capability

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V&V Tools and Techniques

Runtime Viewers

- Viewers reflect mission actions
- Known Agents list populated
- Active skills displayed
- Shot Lines show status of engagement
- Agent location, speed, posture tracked
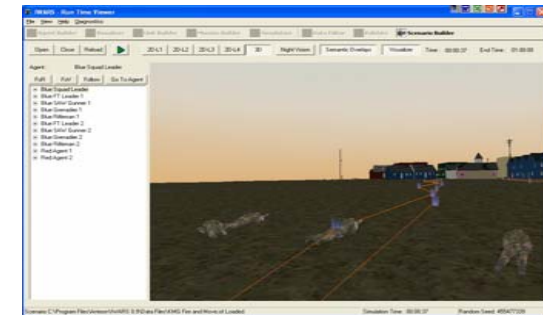
Output Analysis Tool

- Track acquisitions, engagements, communications, behaviors
- Evaluated conditions correctly begin/end skills
- Events filtered for in-depth post-processing
- Events saved in CSV format for follow on processing

Custom Logs / Script Files

- Flexibility to track items not in Output Tool
- Formatted to support follow on processing
- Automatic running of study cases by batch file

Collection of Tools and Results Used to Verify Model

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Problem Reporting

Problem Identification

- Single POC at AMSAA to coordinate submissions and filter redundant requests

- Type of issue identified (Incorrect Functionality, Feature Enhancement)

- Severity and priority of issue determined

Problem Reporting Process

- AMSAA/Natick identify and document issues

- Issues entered through web-based product (Test Track Pro)

- Contractor reviews and assigns issues for correction

- Contractor completes fixes and logs status

- New software drop received and installed by AMSAA/Natick

- AMSAA/Natick retest fixed entries and either close or re-open issues for further work
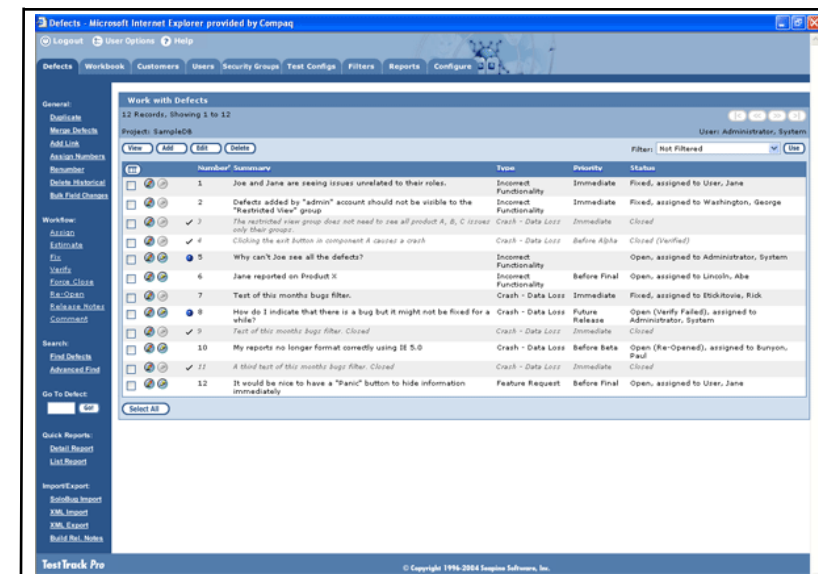
V&V Review Areas

- Review addressed required capabilities delivered in v1.0

- Review depends on nature of required capability:

  - Methodology: numerical results of IWARS compared to stand-alone model or equation results

  - Behavior: skill must alter data structures, be reflected in viewers, and be correctly represented in the database of output events

  - Documentation: rated on clarity, accuracy, usability

  - Architecture: analysis of software structure, flexibility, maintainability

    Usability - input/execution/output assessed for setup time, runtime, ease of access, audit capability

Reviews Determine Degree to Which Requirements Have Been Met

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V&V Effort

- Number of scenarios developed: ~130 (does not include pilot study scenarios)

- Number of test cases run: ~600 (does not include pilot study runs)

  - Parameters varied from run to run to test performance over wide range of inputs/conditions

  - A particular run was often used for multiple tests

- Number of items reported: 117 (only significant outstanding problems were highlighted during the final presentation)

- Specific examples of results presented are representative of tests performed in that V&V area

- Results present summary of findings based on numerous runs, test cases, varying inputs/conditions etc.

V&V Results

- IWARS V&V Results organized by Soldier functionality:
    - Mobility
    - Lethality
    - Search and Target Acquisition
    - Communications
    - Suppression
- Integrated approach combines results from the major capability areas:
    - Methodology
    - Behaviors
    - Data

**IWARS Results Organized According to Soldier Functionality**

Technology to the Warfighter Quicker

IWARS Mobility Features

Agent Mobility capabilities in IWARS:

- Movement to waypoints and along paths
- Movement into and within buildings
- Ability to choose path within nodal networks (based on user selected criteria)
- Take correct position in formations (according to soldier role) and maintain that position while moving
- Maintain correct speed as a function of posture, terrain and fatigue
- Avoid collisions
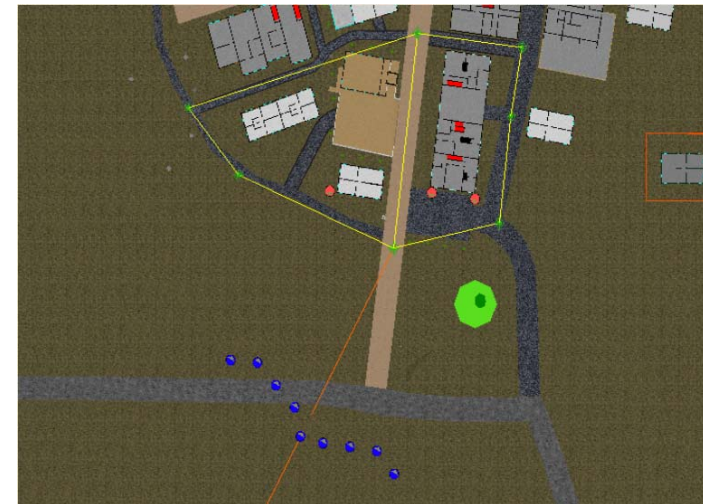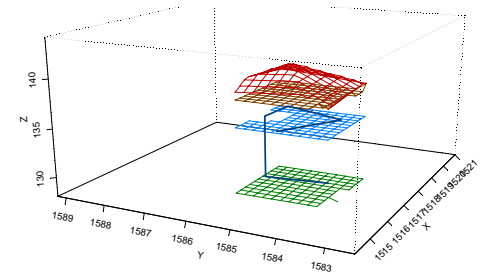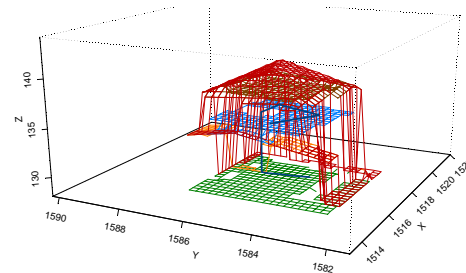
Mobility Testing

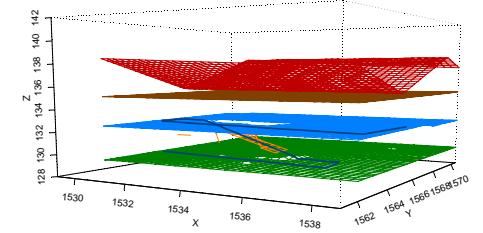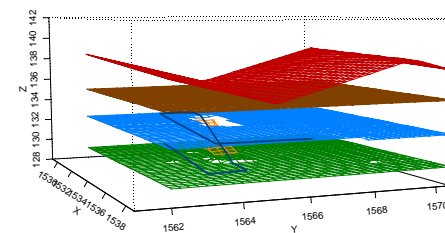| **Navigation**	**Monitor Speed**	**Avoid Collisions**	**Align with Unit**	**Move in Formation**

Navigation
- Verify agents can navigate to points, along paths, and along node networks
- Ensure navigation can be done in open terrain as well as interior structures
- Verify agents can determine and maneuver across terrain
- Make maneuver decisions based on force strength

Results
- Agents successfully navigate to points, along paths, and along node networks
- Navigation successfully done in open terrain as well as in rooms, stairwells, towers
- Agents maintain contact with terrain skin during movements
- Agents also have ability to traverse tunnels and ladders
- "Dead force counts and percentages" not working - force strength decisions cannot be used

Technology to the Warfighter Quicker

Mobility Testing

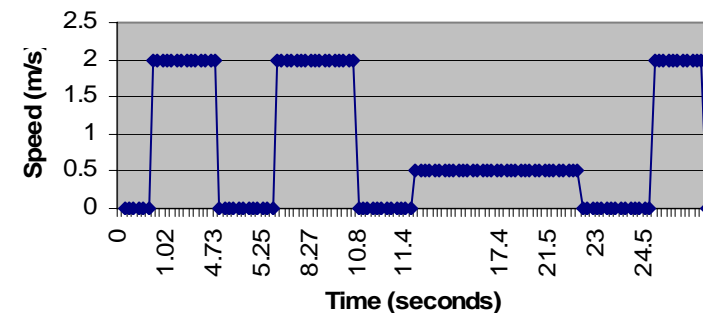| Navigation	**Monitor Speed**	Avoid Collisions	Align with Unit	Move in Formation

Monitor Speed

- Determine if movement speeds are adjusted due to terrain or fatigue
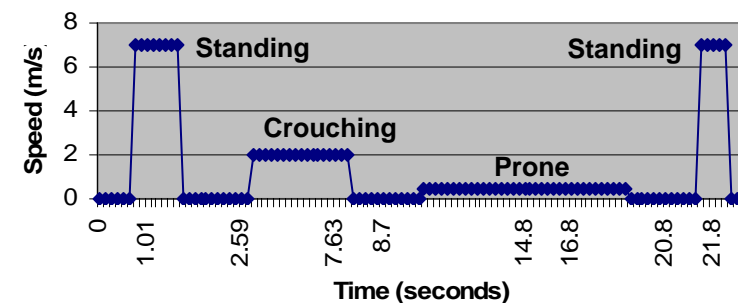- Verify maximum speeds per posture are not exceeded

Results

- Movement speeds are not adjusted due to terrain or fatigue
- Movement speeds remain constant to the next waypoint
- Agents do not exceed maximum speeds per posture

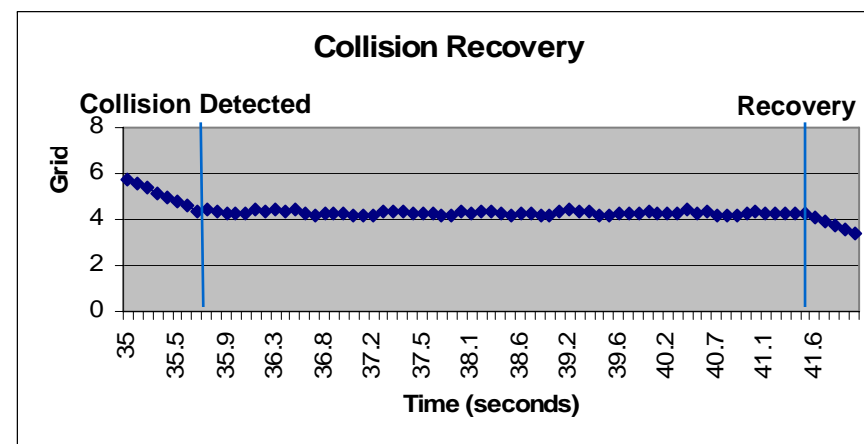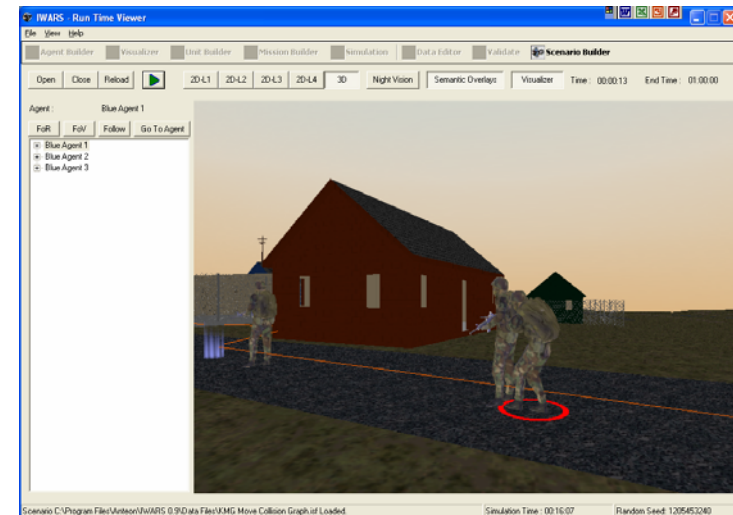**Constant Agent Speeds**

Max Speeds Allowed

Mobility Testing

Navigation	Monitor Speed	**Avoid Collisions**	Align with Unit	Move in Formation

Avoid Collisions

- Determine agent ability to detect possible collision during movement
- Determine agent ability to avoid or recover from collisions

Results

- Agents successfully determine collisions with terrain features and other agents
- Agents use simplistic collision recovery methodology (move along random direction vector until past obstacle)
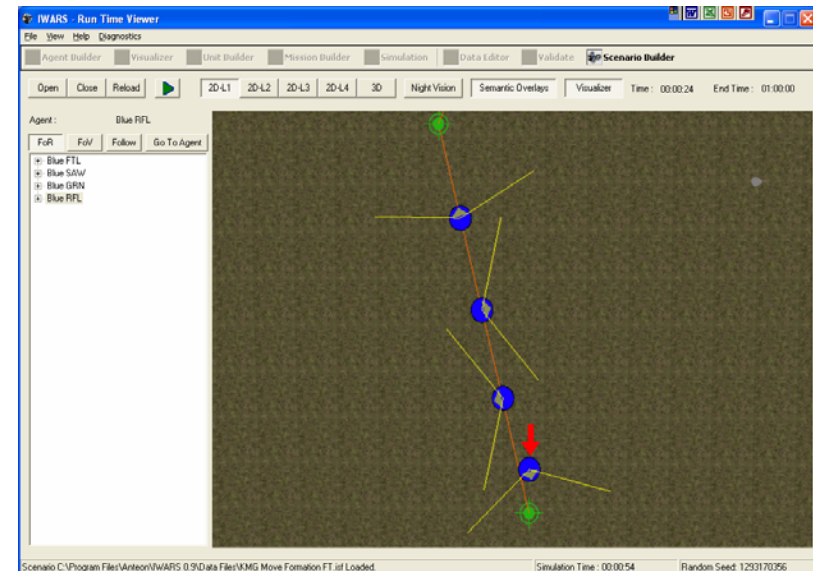

Technology to the Warfighter Quicker

Mobility Testing

Navigation	Monitor Speed	Avoid Collisions	**Align with Unit**	Move in Formation

Align with Unit

- Verify agents align themselves properly in various unit configurations (Buddy Team, Fire Team, Squad, Platoon)

- Ensure agents know unit roles and movement responsibilities

Results

- Agents successfully aligned in various unit configurations (Buddy Team, Fire Team, Squad, Platoon)

- Agents know unit roles and take correct spot in formation

- Agents set FOR according to location in formation

Technology to the Warfighter Quicker

Mobility Testing

Navigation	Monitor Speed	Avoid Collisions	Align with Unit	**Move in Formation**

Move in Formation

- Verify model supports correct infantry formations (Column, Diamond, File, Line, Wedge)
- Verify relative agent positioning and offsets during formation moves
- Verify agents maintain correct speeds
- Ensure agents execute correct Field of Regard searches according to role in formation

Results

- Model correctly represents infantry formations
- Relative agent positioning and offsets maintained during formation moves
- Individual agent speeds adjust to maintain relative position
- Agent spacing is static and cannot be altered dynamically
- Agents undertake correct Field of Regard searches according to role

Technology to the Warfighter Quicker
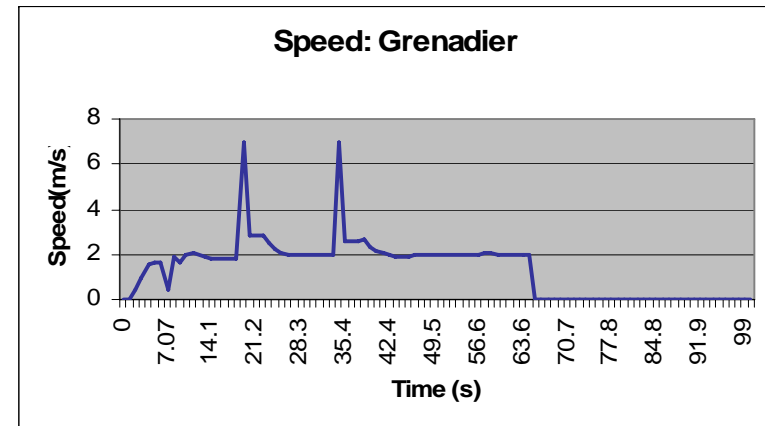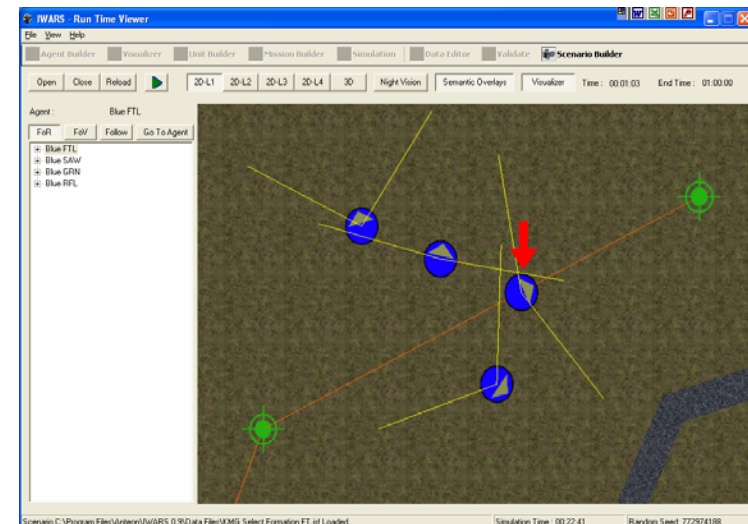
Release Approval

Based on the results of the current AMSAA IWARS V&V and Pilot Study, IWARS is suitable for use* in the following types of direct-fire, small-unit engagement analysis applications:

- Soldier Sensor Performance Analyses

- Soldier Small-Arms Lethality Analyses

- Soldier Survivability Analyses

- Limited Situational Awareness / Battle Command Analyses

IWARS is Ready to Start Aiding in Army Infantry Analyses

* Certain assumptions and limitations apply

Technology to the Warfighter Quicker

Current Status

Sample studies being performed

- Close Combat Armament System (CCAS) comparison study
- Two-sided engagement enhancement to CCAS study
- Joint Chemical Agent Detector (JCAD) utility study

Development for next release continuing

- Expanded capabilities list being finalized
- New missions, threats, environments being prioritized

Ongoing Development to Provide Additional Capabilities

Questions?

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